Interview Summary	Application No.	Applicant(s)
	09/277,171	BROWNE, CAMERON BOLITHO
	Examiner	Art Unit
	Javid A. Amini	2672

All participants (applicant, applicant's representative, PTO personnel):

(1) Javid A. Amini. (3) David Devine.

(2) Jeffrey Brier. (4) Matt Neil.

Date of Interview: 09 June 2005.

Type: a)☐ Telephonic b)☐ Video Conference
c)☒ Personal [copy given to: 1)☐ applicant 2)☒ applicant's representative]

Exhibit shown or demonstration conducted: d)☐ Yes e)☒ No.
If Yes, brief description: _____.

Claim(s) discussed: 1,19 and 32.

Identification of prior art discussed: Becker, Cosman and Griffith et al..

Agreement with respect to the claims f)☐ was reached. g)☒ was not reached. h)☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: See Continuation Sheet.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WHICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

Jeffrey A. Brier

Examiner's signature, if required

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record
A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews
Paragraph (b)
In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.
All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:

- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

1) A brief description of the nature of any exhibit shown or any demonstration conducted,
2) an identification of the claims discussed,
3) an identification of the specific prior art discussed,
4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
5) a brief identification of the general thrust of the principal arguments presented to the examiner,
   (The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
6) a general indication of any other pertinent matters discussed, and
7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

Continuation of Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: The amended claims filed on March 1, 2005 overcomes the previous rejection.Applicant requestes to reconsider the combination of the terms used in claim 1 section (d) " substantially uniform opacity". Examiner's reply: The specification does not support what exactly the Applicant means by using these terms, because the substantially uniform opacity level might range from completely transparent (0) to completely opaque (100). These terms need to be clarified. Also Applicant in claim 1, second line, claims "the images to be displayed on a display device or printed", while in claim 19 claims "the step of varying the opacity of one or more of the shape elements over time, and periodically rendering the shape elements". The following question needs to be clarified: Does Applicant means CRT type of display or printed hard copy? The Applicant requests to clarify the statement that Examiner on page 2 of previous office action, third paragraph made about the Gaussian function is a function of time. Examiner refers to figs. 7B and 7A of Becker's work, illustrate the Gaussian distribution (that is well known in the art) with time constant. Whenever a person skill in the art considers type of display (meaning life of a pixel) then Gaussian distribution may be considered as time variant function. FYI.... Examiner encloses a material regarding Gaussian distribution, "Abrief Introduction to continous life distributions Random Variables" the link for this subject can be found as follows:http://www.weibull.com/SystemRelWeb/a_brief_introduction_to_continuous_life_distributions.htm .

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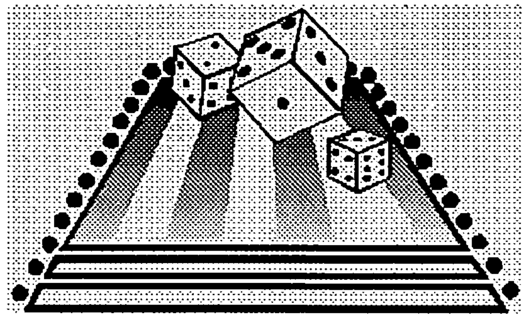
A Brief Introduction to Continuous Life Distributions
Random Variables



In general, most problems in reliability engineering deal with quantitative measures, such as the time-to-failure of a product, or qualitative measures, such as whether a product is defective or non-defective. We can then use a *random variable* X to denote these possible measures.

In the case of times-to-failure, our random variable X is the time-to-failure of the product and can take on an infinite number of possible values in a range from 0 to infinity (since we do not know the exact time *a priori*). Our product can be found failed at any time after time 0 (*e.g.* at 12 hours or at 100 hours and so forth), thus X can take on any value in this range. In this case, our random variable X is said to be a *continuous random variable*. In this reference, we will deal almost exclusively with continuous random variables.

In judging a product to be defective or non-defective, only two outcomes are possible. That is, X is a random variable that can take on one of only two values (let's say defective = 0 and non-defective = 1). In this case, the variable is said to be a *discrete random variable*.

The Probability and Cumulative Density (Distribution) Functions

The probability density function (*pdf*) and cumulative distribution function (*cdf*) are two of the most important statistical functions in reliability and are very closely related. When these functions are known, almost any other reliability measure of interest can be derived or obtained. We will now take a closer look at these functions and how they relate to other reliability measures, such as the reliability function and failure rate.

Designations

From probability and statistics, given a continuous random variable X we denote:

- The probability density (distribution) function, *pdf*, as $f(x)$.
- The cumulative distribution function, *cdf*, as $F(x)$.

The *pdf* and *cdf* give a complete description of the probability distribution of a random variable. Figure 3.3 illustrates a *pdf* while Figure 3.4 illustrates the *pdf-cdf* relationship.

Definitions

If X is a continuous random variable, then the *probability density function*, *pdf*, of X is a function, $f(x)$, such that for two numbers, a and b with $a \leq b$:

$$P(a \leq X \leq b) = \int_a^b f(x)dx \quad (9)$$

That is, the probability that X takes on a value in the interval [a, b] is the area under the density function from a to b as shown in Figure 3.3. The *pdf* represents the relative frequency of failure times as a function of time.

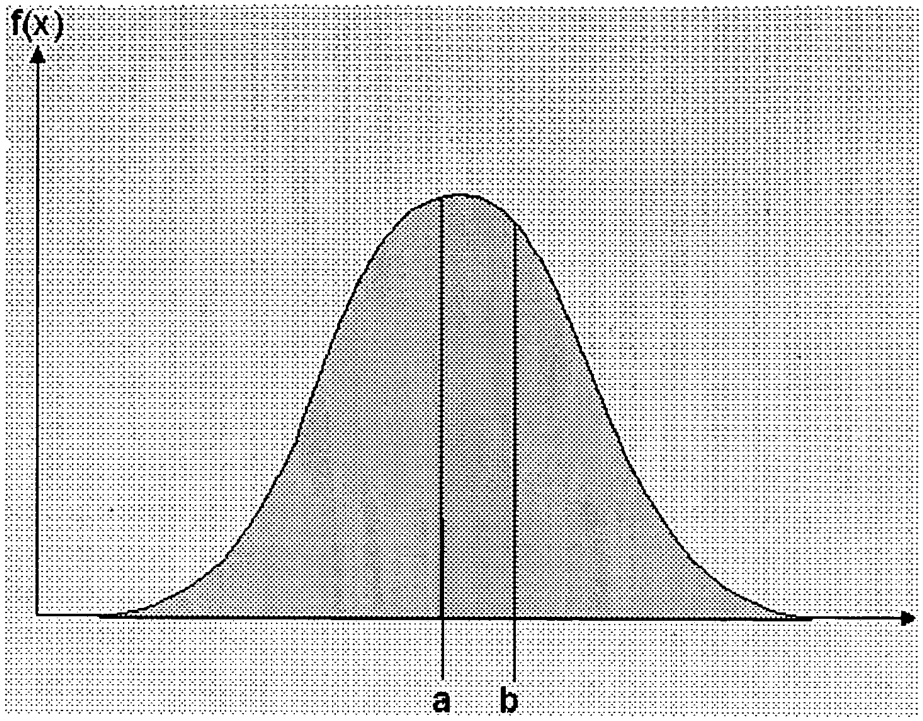


Figure 3.3: Example of a *pdf*.

The cumulative distribution function, *cdf*, is a function, $F(x)$, of a random variable X, and is defined for a number x by:

$$F(x) = P(X \leq x) = \int_0^x f(s)ds \quad (10)$$

That is, for a number x, $F(x)$ is the probability that the observed value of X will be at most x. The *cdf* represents the cumulative values of the *pdf*. That is, the value of a point on the curve of the *cdf* represents the area under the curve to the left of that point on the *pdf*. In reliability, the *cdf* is used to measure the probability that the item in question will fail before the associated time value, *t*, and is also called *unreliability*.

Note that depending on the distribution function, denoted by $f(x)$, the limits will vary based on the region over which the distribution is defined. For example, for the life distributions considered in this reference, with the exception of the normal distribution, this range would be [0,+∞].

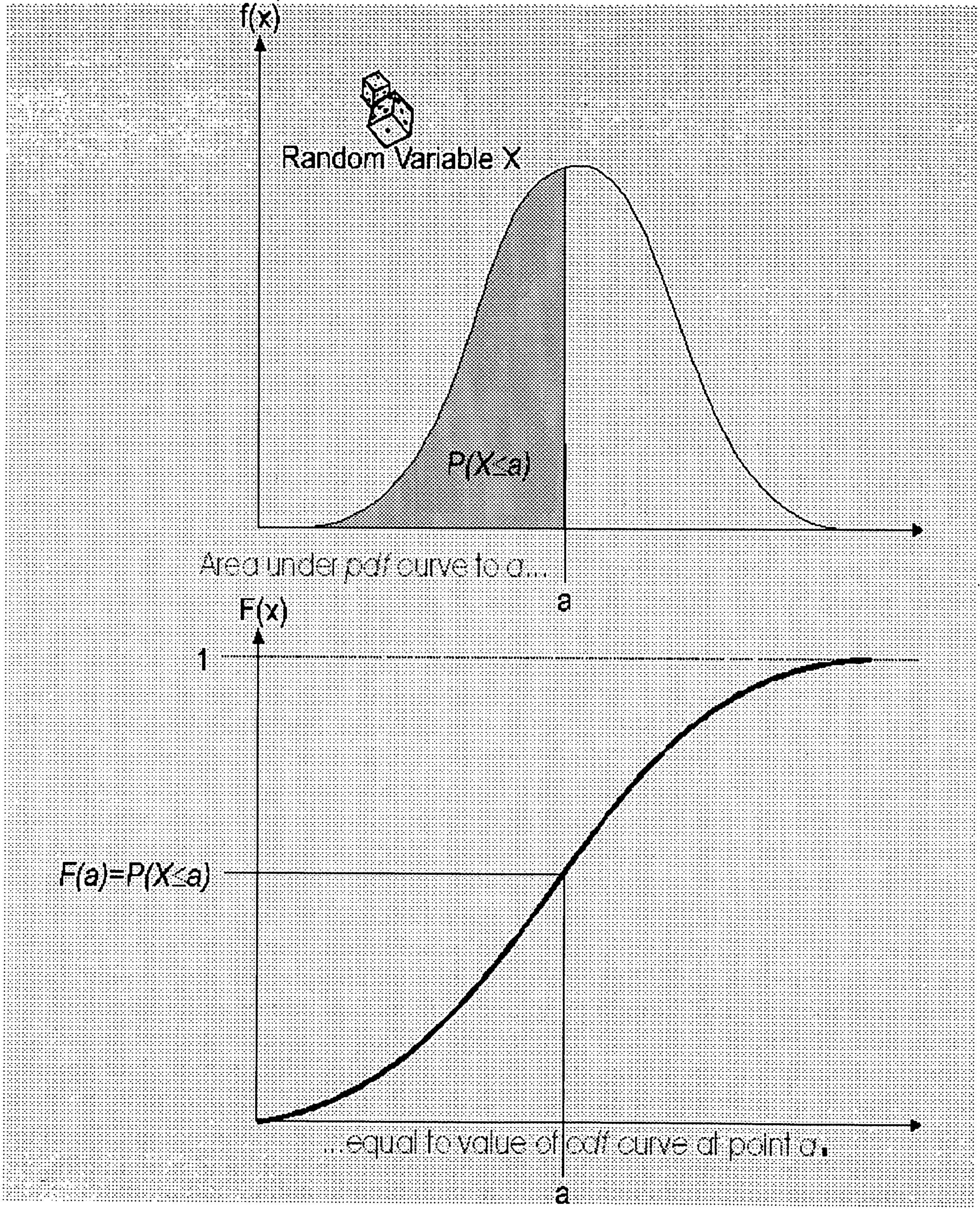


Figure 3.4: Graphical representation of the relationship between *pdf* and *cdf*.

Mathematical Relationship Between the *pdf* and *cdf*

The mathematical relationship between the *pdf* and *cdf* is given by:

$$F(x) = \int_0^x f(s)ds \tag{11}$$

Where *s* is a dummy integration variable.

Conversely:

$$f(x) = \frac{d(F(x))}{dx}$$

The *cdf* is the area under the probability density function up to a value of *x*. The total area under the *pdf* (Figure 3.5) is always equal to 1, or mathematically:

$$\int_0^{\infty} f(x)dx = 1$$

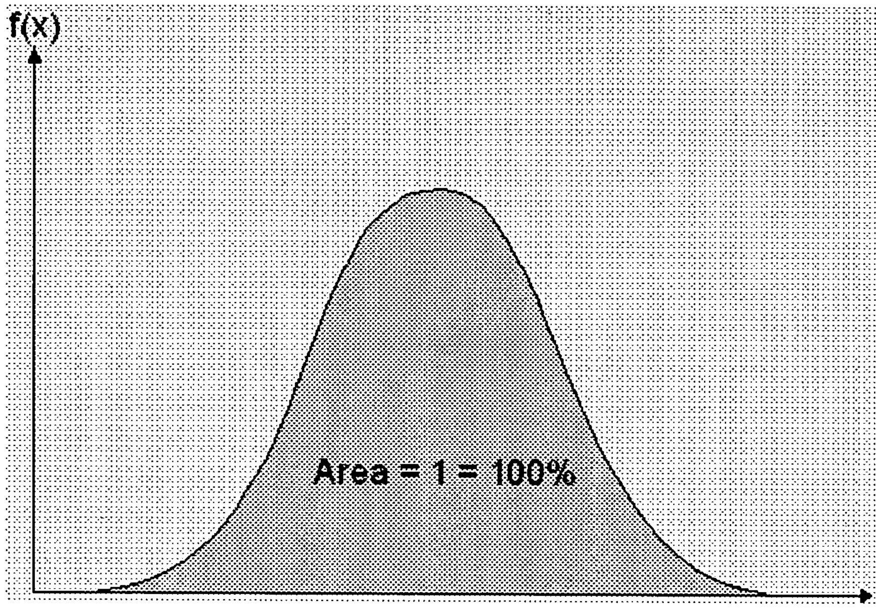


Figure 3.5: Total area under a *pdf*.

The well-known normal (or Gaussian) distribution is an example of a probability density function. The *pdf* for this distribution is given by:

$$f(t) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{t-\mu}{\sigma}\right)^2}$$

Where μ is the mean and σ is the standard deviation. The normal distribution is a two-parameter distribution having two parameters, μ and σ. (Note: Since we will be dealing with times-to-failure in this reference, we will henceforth replace the random variable *x* with *t*.)

Another is the lognormal distribution, whose *pdf* is given by:

$$f(t) = \frac{1}{t \cdot \sigma' \sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{t'-\mu'}{\sigma'}\right)^2}$$

where μ' is the mean of the natural logarithms of the times-to-failure and σ' is the standard deviation of the natural logarithms of the times-to-failure. Again, this is a two-parameter distribution.

The Reliability Function

The reliability function can be derived using the previous definition of the cumulative distribution function, Eqn. (11). From our definition of the *cdf*, the probability of an event occurring by time *t* is given by:

$$F(t) = \int_0^t f(s)ds \tag{12}$$

Or, one could equate this event to the probability of a unit failing by time *t*.

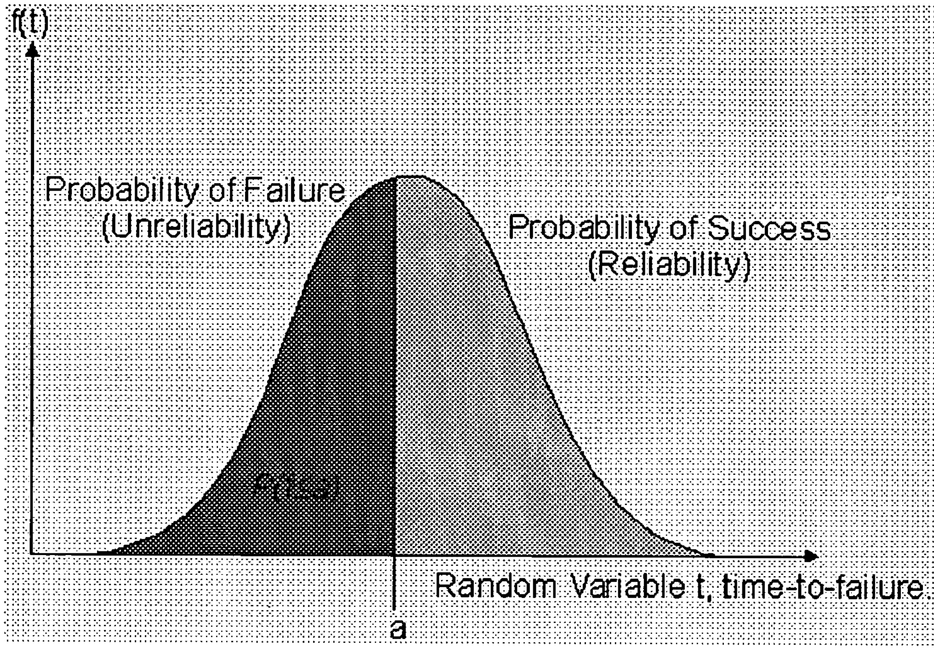


Figure 3.6: Reliability as area under *pdf*.

Since this function defines the probability of failure by a certain time, we could consider this the *unreliability* function. Subtracting this probability from 1 will give us the *reliability* function, one of the most important functions in life data analysis. The reliability function gives the probability of success of a unit undertaking a mission of a given time duration. Figure 3.6 illustrates this.

To show this mathematically, we first define the unreliability function, $Q(t)$, which is the probability of failure, or the probability that our time-to-failure is in the region of 0 and t. This is the same as the *cdf*. So from Eqn. (12):

$$Q(t) = F(t) = \int_0^t f(s)ds$$

Reliability and unreliability are the only two events being considered and they are mutually exclusive; hence, the sum of these probabilities is equal to unity. Then:

$$\begin{aligned} Q(t) + R(t) &= 1 \\ R(t) &= 1 - Q(t) \\ R(t) &= 1 - \int_0^t f(s)ds \\ R(t) &= \int_t^\infty f(s)ds \end{aligned}$$

Conversely:

$$f(t) = -\frac{d(R(t))}{dt}$$

The Conditional Reliability Function

Conditional reliability is the probability of successfully completing another mission following the successful completion of a previous mission. The time of the previous mission and the time for the mission to be undertaken must be taken into account for conditional reliability calculations. The conditional reliability function is given by:

$$R(T,t) = \frac{R(T+t)}{R(T)} \quad (13)$$

The Failure Rate Function

The failure rate function enables the determination of the number of failures occurring per unit time. Omitting the derivation, the failure rate is mathematically given as:

$$\lambda(t) = \frac{f(t)}{R(t)} \quad (14)$$

This gives the instantaneous failure rate, also known as the hazard function. It is useful in characterizing the failure behavior of a product, determining maintenance crew allocation, planning for spares provisioning, etc. Failure rate is denoted as failures per unit time.

Mean Life (MTTF)

The mean life function, which provides a measure of the average time of operation to failure, is given by:

$$\overline{T} = m = \int_0^{\infty} t \cdot f(t)dt$$

This is the expected or average time-to-failure and is denoted as the $MTTF$ (Mean Time To Failure). (Note: Many practitioners and authors mistakenly refer to this metric as the $MTBF$, Mean Time Between Failures. The two metrics are identical if the failure rate of the component or system is constant. However, if the failure rate is not constant then the mean time to failure and the mean time between failures are not the same! Furthermore, $MTBF$ only becomes meaningful when dealing with repairable systems. We will explore the $MTBF$ metric in the Repairable Systems Analysis Through Simulation chapter of this on-line reference.)

The $MTTF$, even though an index of reliability performance, does not give any information on the failure distribution of the product in question when dealing with most lifetime distributions. Because vastly different distributions can have identical means, it is unwise to use the $MTTF$ as the sole measure of the reliability of a product.

Median Life

Median life, $\breve{T}$, is the value of the random variable that has exactly one-half of the area under the *pdf* to its left and one-half to its right. It represents the centroid of the distribution. The median is obtained by solving the following equation for $\breve{T}$. (For individual data, the median is the midpoint value.)

$$\int_0^{\breve{T}} f(t)dt = 0.5 \quad (15)$$

Modal Life

The modal life (or mode), $\tilde{T}$, is the value of T that satisfies:

$$\frac{d[f(t)]}{dt} = 0 \quad (16)$$

For a continuous distribution, the mode is that value of t that corresponds to the maximum probability density (the value at which the *pdf* has its maximum value, or the peak of the curve).

Distributions

A statistical distribution is fully described by its *pdf*. In the previous sections, we used the definition of the *pdf* to show how all other functions most commonly used in reliability engineering and life data analysis can be derived. The reliability function, failure rate function, mean time function, and median life function can be determined directly from the *pdf* definition, or $f(t)$. Different distributions exist, such as the normal (Gaussian), exponential, Weibull, etc., and each has a predefined form of $f(t)$ that can be found in many references. In fact, there are certain references that are devoted exclusively to different types of statistical distributions. These distributions were formulated by statisticians, mathematicians and engineers to mathematically model or represent certain behavior. For example, the Weibull distribution was formulated by Waloddi Weibull and thus it bears his name. Some distributions tend to better represent life data and are most commonly called lifetime distributions.

The exponential distribution is one of the simplest and most commonly used distributions. (Note: Most commonly used does not mean most commonly appropriate. The exponential distribution assumes a constant failure rate, an assumption that is inappropriate for most real cases. The reason for its overuse is its mathematical simplicity.) The *pdf* of the exponential distribution is mathematically defined as:

$$f(t) = \lambda e^{-\lambda t}$$

In this definition, note that t is our random variable representing time and the Greek letter λ (lambda) represents what is commonly referred to as the *parameter* of the distribution. For any distribution, the parameter or parameters of the distribution are estimated from analysis of the data. For example, in the case of the most well-known distribution, namely the normal (or Gaussian) distribution, the *pdf* is given by:

$$f(t) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{t-\mu}{\sigma}\right)^2}$$

Where the mean, μ and the standard deviation, σ are its parameters. Both of these parameters are estimated from the data (*i.e.* the mathematical mean and standard deviation of the sample data are used to represent the parameters for the entire population). Once these parameters have been estimated, our function, $f(t)$, is fully defined and we can obtain any value for $f(t)$ given a value of t.

Given the mathematical representation of a distribution, we can also derive all of the functions needed for life data analysis. These functions will also depend only on the value of t after the value of the distribution parameters have been estimated from data.

For example, we know that the exponential distribution *pdf* is given by:

$$f(t) = \lambda e^{-\lambda t}$$

Thus, the reliability function can be derived by:

$$\begin{aligned} R(t) &= 1 - \int_0^t \lambda e^{-\lambda T} dT \\ &= 1 - \left[1 - e^{-\lambda t}\right] \\ &= e^{-\lambda t} \end{aligned}$$

The failure rate function is given by:

$$\begin{aligned} \lambda(t) &= \frac{f(t)}{R(t)} \\ &= \frac{\lambda e^{-\lambda(t)}}{e^{-\lambda(t)}} \\ &= \lambda \end{aligned}$$

The Mean Time To Failure (MTTF) is given by:

$$
\begin{aligned}
\overline{T} &= \int_0^{\infty} t \cdot f(t)dt \\
&= \int_0^{\infty} t \cdot \lambda \cdot e^{-\lambda t}dt \\
&= \frac{1}{\lambda}
\end{aligned}
$$

Exactly the same methodology can be applied to any distribution given its *pdf* with various degrees of difficulty depending on the complexity of $f(t)$.

Commonly Used Distributions

There are many different lifetime distributions that can be used. ReliaSoft [23] presents a thorough overview of commonly used lifetime distributions. Leemis [15] and others also present a good overview of many of these distributions.

See Also:
Statistical Background

Go to weibull.com
Go to ReliaSoft.com